Resistant Palmer Amaranth in Arizona

Blase Evancho
Assistant-in-Extension
Field Crops

2021 Winter Field Crops Clinic
1/26/2021
Glyphosate resistant Palmer amaranth in Arizona

- Parker – alfalfa
- Buckeye – cotton
- Maricopa – corn, cotton
- Coolidge – cotton
- Red Rock – pecans
- Marana – cotton, alfalfa
- Pearce – corn, cotton
- Safford – ditch bank, cotton
- San Simon – pecans

Also hairy fleabane
Palmer amaranth (Carelessweed, Pigweed)

Robust dioecious annual reproduces by seed.
Seed production = 600,000 to 1.6 million seeds per large female.
An infestation can produce 375 million seeds per foot of crop row.
Long-term seedbank longevity unknown, but lost 85% viability after 3 years.
Palmer amaranth is dioecious – obligate outcrosser
Male Palmer amaranth - Male flowers with yellow anther sacs

Glyphosate resistance can move in pollen and seed!

Female Palmer amaranth flowers

Photo credits: Bill McCloskey, University of Arizona
Palmer Amaranth & ivyleaf morningglory competition with cotton (2 leaf) following simultaneous emergence.

Photo credit: Bill McCloskey, University of Arizona (above)
Palmer Amaranth – Rapid Growth ($C_4$)

- Rapid growth rate
- $C_4$ photosynthesis (uses all available light)
- $>80 \ \mu\text{mol CO}_2 \ \text{m}^2 \ \text{s}^{-1}$ compared to $35 \ \mu\text{mol CO}_2 \ \text{m}^2 \ \text{s}^{-1}$ for cotton
  (Photosynthesis $= 2.3 \times$ cotton)
- High temperature growth optimum
- Greater water use efficiency

Photo credit: Bill McCloskey, University of Arizona (above)

• Year 1 (2008)
  – 20,000 seed/1 m² circle (February)
  – Palmer infested 0.56% of field area
  – No yield loss

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  – Lint yield reduced 42 lb/A

Photo credit: Blase Evancho, University of Arizona

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• Year 2 (2009)
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• Year 3 (2010)
  – Palmer infested 95 to 100% of field
  – No lint yield/field was not physically harvestable
Tactics that may control and delay or avoid developing herbicide resistant weeds

<table>
<thead>
<tr>
<th>Herbicides</th>
<th>Mechanical</th>
<th>Cultural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple herbicides with different mechanisms of action</td>
<td>Tillage</td>
<td>Crop rotation</td>
</tr>
<tr>
<td>Mixes</td>
<td><em>Pre-plant</em></td>
<td>Plant population</td>
</tr>
<tr>
<td>Sequences</td>
<td>In-crop cultivation</td>
<td>Row spacing</td>
</tr>
<tr>
<td>Across seasons</td>
<td>In-row weeding</td>
<td>Planting date</td>
</tr>
<tr>
<td></td>
<td>Post-harvest</td>
<td>Fertilizer placement</td>
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<td></td>
<td>Hand-rogueing before seed set</td>
<td>Cover crops</td>
</tr>
</tbody>
</table>
Prowl H₂O (0.95 lb/A) applied PPI
(field cultivator, listed, mulched, bed-shaped)

Photo credits: Bill McCloskey, University of Arizona
### Cotton Post-Direct and Layby Herbicides

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>PREE</th>
<th>Soil Activity</th>
<th>General Crop Rotation</th>
<th>Foliar Herbicide Type/Activity</th>
<th>Mid-POST</th>
<th>Soil Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prowl H2O (pendimethalin)</td>
<td>Yes</td>
<td>None</td>
<td>Medium-Long</td>
<td>None</td>
<td>6 to 15 inches tall</td>
<td>1 to 1.6 ft. oz./A – do not spray green stems</td>
</tr>
<tr>
<td>Prometryn</td>
<td>Yes</td>
<td>Contact</td>
<td>Short</td>
<td>Contact</td>
<td>NO</td>
<td>Post-direct at crop base or use shields @ 6:12 cotton</td>
</tr>
<tr>
<td>Diuron</td>
<td>Yes</td>
<td>Contact</td>
<td>Long</td>
<td>Contact</td>
<td>NO</td>
<td>Post-direct at crop base or use shields @ 6:12 cotton</td>
</tr>
<tr>
<td>Chateau (flumioxazin)</td>
<td>YES</td>
<td>Contact</td>
<td>Short with tillage</td>
<td>Contact</td>
<td>NO</td>
<td>1-2 oz./A for post-direct burndown 2 oz./A @ layby on all soil types</td>
</tr>
<tr>
<td>Fierce (flumioxazin + pyroxasulfone)</td>
<td>YES</td>
<td>Contact</td>
<td>Long</td>
<td>Contact</td>
<td>NO</td>
<td>6-8” – 0.4 lb. a.i./A (0.4 pt./A) 8-12” – 0.6 lb. a.i./A &gt;12” – 0.8-1.2 to 0.8-1.6 lb. a.i./A based on soil type</td>
</tr>
<tr>
<td>Aim (carfentrazone)</td>
<td>NO</td>
<td>Contact</td>
<td>None-registered crops</td>
<td>Contact</td>
<td>NO</td>
<td>0.5 to 1 ft. oz./A – do not spray green stems Post-direct at crop base or use shields @ 6:12 cotton</td>
</tr>
<tr>
<td>ET (pyraflufen)</td>
<td>NO</td>
<td>Contact</td>
<td>Short (30 days)</td>
<td>Contact</td>
<td>NO</td>
<td>&gt;6” – &gt;0.5-0.65 lb. a.i./A &gt;12” – 1.2-1.6 lb. a.i./A on sandy loam soils &gt;12” – &gt;1.5 lb. a.i./A on loam and heavier soils</td>
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**Consider tank-mixes:**
- PPO inhibitors (Aim, ET) + prometryn or diuron
- Glyphosate + either prometryn, diuron, or glufosinate

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**Mid-Post & Layby Herbicides (non-selective)**

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<tr>
<th>Herbicide</th>
<th>Activity</th>
<th>Post-Directed</th>
<th>Soil Activity</th>
<th>Mid-POST</th>
<th>Soil Activity</th>
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<tr>
<td>Aim</td>
<td>NO</td>
<td>1 to 1.6 ft. oz./A – do not spray green stems</td>
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<tr>
<td>ET</td>
<td>NO</td>
<td>0.5 to 1 ft. oz./A – do not spray green stems Post-direct at crop base or use shields @ 6:12 cotton</td>
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<td>Oxyfluorfen</td>
<td>Yes</td>
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**Preplant – Residual Herbicides**

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<th>Herbicide</th>
<th>Early Post – Mid Post (sequential sprays)</th>
<th>Selective Chemistries (with appropriate varieties)</th>
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<tbody>
<tr>
<td>Pendimethalin</td>
<td>Dual Magnum (metoachlor)</td>
<td>Warrant (acetochlor)  	Outlook (dimethenamid-P)</td>
</tr>
<tr>
<td>Trifuralin</td>
<td>Pendimethalin (microencapsulated H2O formulations)</td>
<td></td>
</tr>
<tr>
<td>Prometryn</td>
<td>Glyphosate</td>
<td></td>
</tr>
<tr>
<td>Diuron</td>
<td>Glufosinate (Liberty, Interline)</td>
<td></td>
</tr>
<tr>
<td>Soilscarm</td>
<td>2,4-D-choline (Enlist One)  	2,4-D-choline-glyphosate (Enlist Duo)</td>
<td></td>
</tr>
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</table>

*Rates depend on soil type – consult labels*

- Dicamba (Engenia, Abладинmax)
- Pyrihlopec (Staple LX, Trifoxysulfuron (Envoke)
- Gramicides: fluazifop, sethoxydim, cethodim (Fusilade, Prost; Select)
Resistant Palmer Task Force

• Produce & share information on herbicide resistant Palmer amaranth to attempt to slow and contain pest.
• Monitor and inventory this pest in our agricultural landscape.
• Incentivize IPM tools that will make the largest impacts.

Thank you to all collaborators and supporters